The use of digital technologies across the adult life span in distance education

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Abstract

In June 2010, a survey was carried out to explore access to digital technology, attitudes to digital technology and approaches to studying across the adult life span in students taking courses with the UK Open University. In total, 7000 people were surveyed, of whom more than 4000 responded. Nearly all these students had access to a computer and the Internet, but younger students were more likely than older students to have access to other technologies, to spend longer time using those technologies and to have more positive attitudes to digital technology. However, there was no evidence for any discontinuity around the age of 30, as would be predicted by the "Net Generation" and "Digital Natives" hypotheses. Older students were more likely than younger students to adopt deep and strategic approaches to studying and less likely to adopt a surface approach to studying. In addition, regardless of their ages, students who had more positive attitudes to technology were more likely to adopt deep and strategic approaches to studying and were less likely to adopt a surface approach to studying.

Introduction

This study was concerned with access to digital technology, attitudes to digital technology and approaches to studying among younger and older students in higher education. We begin by providing a synthesis of the recent literature on students' use of digital technologies.

The twenty-first century has seen the wholesale introduction of a wide variety of digital technologies in higher education. Institutions routinely use learning management systems (virtual learning environments) and web-based applications to deliver both the curriculum and student support (see Brown *et al*, 2010; Hawkins & Rudy, 2008, for recent surveys of the situation in the UK and the USA respectively). This has been matched by changes in the use of such technologies on the part of students themselves. In the USA, for instance, Smith and Caruso (2010, pp. 41–42) found that 98% of undergraduate students owned their own computers, and 63% also owned an internet-capable handheld device such as an iPhone. Students were sometimes asked to use digital tools by their teachers, but more often, they adapted the tools that they used in their personal lives to fit their academic context. The situation in the UK is broadly similar (*Student perspectives on technology*, 2010).

The increased use of digital technologies among young adults in general has led some writers to argue that they constitute a distinct population who think and learn in qualitatively different

Practitioner Notes

What is already known about this topic

- Younger students have more access to digital technology and more positive attitudes to such technology than older students.
- Students who have more positive attitudes to technology are more likely to adopt deep and strategic approaches to studying and are less likely to adopt a surface approach.
- Nevertheless, older students are more likely to adopt deep and strategic approaches to studying and are less likely to adopt a surface approach than are younger students.

What this paper adds

- Students' use of, and attitudes to, digital technology vary monotonically across the adult lifespan, and there is no evidence for any discontinuity around the age of 30.
- Students' age and their attitudes to digital technology are distinct predictors of their approaches to studying.
- When they have similar access to relevant forms of technology, older students may be more likely than younger students to respond to online surveys.

Implications for practice and/or policy

- Policy-makers and practitioners should reject stereotypes regarding younger and older learners, such as those reflected in the Net Generation and Digital Natives hypotheses.
- Both younger and older students hold broadly positive attitudes to digital technology.
- Whatever their age, today's students regard the use of digital technology as an integral part of their experience of higher education.

ways from older people. This population has been variously called "Millenials" (Strauss & Howe, 1991), the "Net Generation" (Tapscott, 1998), "Digital Natives" (Prensky, 2001a) and "Generation Y" (Jorgensen, 2003). These commentators argue that, because of exposure to technology in people born since the early 1980s, there is a mismatch between their expectations of higher education and the teaching practices that they find on admission (see Oblinger, 2003). Indeed, some argue that young adults' exposure to digital technologies has led to changes in the structure and function of their brains (Prensky, 2001b; Tapscott, 2009, pp. 97–119). Having originally dismissed older people as "digital immigrants" who had to try and adapt to using digital technologies, Prensky (2009) recently acknowledged that they might aspire to achieving "digital wisdom," which he defined as "wisdom arising *from* the use of digital technology to access cognitive power beyond our innate capacity" and "wisdom *in* the prudent use of technology to enhance our capabilities" (p. 1), and he claimed that this too would lead to changes in their brains' organisation and structure.

Such ideas have potentially important implications for teaching and course design in higher education (Howe & Strauss, 2003; Prensky, 2010). Nevertheless, they are essentially speculations for which there is little or no direct evidence (for critical reviews, see Bennett, Maton & Kervin, 2008; Jones, 2011; Selwyn, 2009). Pedró (2009) conducted a meta-analysis of research from countries in the Organisation for Economic Co-operation and Development and found that there was insufficient evidence that students' use of digital technologies had influenced the way that they learned, their preferences and perceptions regarding teaching and learning in higher

education or their general intellectual development. On the contrary, surveys from Australia, the UK and the USA indicate that students are broadly content with the digital technologies that their universities provide and the level of competence shown by their teachers (Dahlstrom, de Boor, Grunwald & Vockley, 2011; Jones, Ramanau, Cross & Healing, 2010; Kennedy, Judd, Churchward, Gray & Krause, 2008; Smith & Caruso, 2010).

Students' attitudes to the use of digital technologies in higher education are important, among other things, because they may be related to their approaches to studying. Goodyear, Asensio, Jones, Hodgson and Steeples (2003) surveyed students who were taking courses at four UK universities delivered by networked learning (see also Goodyear, Jones, Asensio, Hodgson & Steeples, 2005). They found that students who had more positive attitudes were more likely to adopt a deep approach to studying (aimed at understanding the course content), were more likely to adopt a strategic approach to studying (aimed at achieving the highest marks or grades) and were less likely to adopt a surface approach to studying (aimed at being able to reproduce the course materials for the purposes of assessment). Similar results were obtained by Foster and Lin (2007) and by Chen, Lambert and Guidry (2010). However, these results apply to young adults: most research into students' use of and attitudes towards information technologies has either marginalised older students or else ignored them completely.

One exception to this is a survey carried out by Jones *et al* (2010) with students at five English universities (see also Jones & Hosein, 2010). Responses were obtained from 596 (or 33%) of the 1809 students who were surveyed. There were clear age-related differences both in technology use (for instance, with younger students using laptops or handheld devices rather than desktop computers and using newer forms of technology such as wikis, blogs or virtual worlds) and in attitudes to technology (with older students reporting less confidence in their use of digital tools than younger students). Even so, neither the older students nor the younger students constituted a homogeneous group in their use of digital technologies, and there was no evidence for any discontinuity around the age of 30, as would be predicted by the Net Generation and Digital Natives hypotheses. Moreover, other factors (especially gender) were equally important in influencing the students' use of digital technologies. One basic problem with this study was that nearly all of the older students were taking courses by distance learning with the UK Open University, whereas most of the younger students were at campus-based institutions. Consequently, variations in age were directly confounded with differences in the mode of course delivery.

The present study was motivated by a concern that people in the oldest groups might differ in their use of digital technology from younger adults. This is typically attributed to older people having poorer access to technology, less motivation to use technology and fewer digital skills than younger adults (Peacock & Künemund, 2007; Wagner, Hassanein & Head, 2010). At a global level, this "digital divide" is likely to be moderated by gender, class and other characteristics (eg, Graham, 2011; Shieh, Chang & Liu, 2011), but in Western society and especially in higher education, age differences have been identified as being of primary concern. We surveyed 3000 people aged 60 and over who were taking courses by distance learning with the UK Open University and we also included comparison groups of students between the ages of 21 and 59. We asked about their access to digital technologies, their use of digital technologies, their use of assistive technologies and their attitudes to digital technologies. We also asked about their approaches to studying on their courses, because previous research had shown that older students are more likely to adopt a deep approach to studying and less likely to adopt a surface approach to studying than younger students (see Baeten, Kyndt, Struyven & Dochy, 2010, for a review). In other words, we compared access to digital technologies, attitudes to digital technologies and approaches to studying across the adult life span.

Method

Context

The UK Open University was founded in 1969 to provide degree-level programmes by distance education across the UK. Originally, nearly all of its courses were delivered by correspondence materials, combined with television and radio broadcasts, video and audio recordings, tutorial support at a local level and (in some cases) week-long residential schools. Nowadays, however, the Open University makes widespread use of computer-based support, particularly DVDs, subject-support websites and networking sites. Indeed, for most courses, students are expected to have access to a computer and access to the Internet. For most undergraduate courses, the University accepts all applicants over the normal minimum age of 16 without imposing any formal entrance requirements. In the case of postgraduate courses, applicants are expected to have an honours degree or an equivalent qualification. (The Open University has recently changed its terminology so that its course units are now referred to as "modules" rather than as "courses." Nevertheless, the previous terminology was used in the survey instrument, and for consistency, it will be used throughout this paper.)

Traditionally, the majority of the Open University's courses ran from February to October and were weighted at either 30 or 60 credit points, on the basis that full-time study would consist of courses worth 120 credit points in any calendar year. Nowadays, a variety of starting dates, durations and credit weightings are used. Students are permitted to register for two or more courses up to a maximum load of 120 credit points, but the majority register for just one course at a time. Those courses that contribute to the University's undergraduate programme are classified as introductory, intermediate or honours, and since the year 2000, schemes of study that lead to a wide range of named degrees have been introduced. Even so, the programme retains a modular structure in which prerequisite requirements are minimised. Some courses are assessed by a combination of written assignments (submitted by post or online) and traditional unseen examinations (taken at regional assessment centres); however, an increasing number of courses are assessed by written assignments alone.

Participants

Given the total numbers of students available to be surveyed under the Open University's normal procedures (which among other things preclude any student being asked to participate in more than two research projects in any year), it was decided to draw 2000 students at random from those aged 60–69 and 1000 students at random from those aged 70 and over. Further random samples of 1000 students were drawn from those aged 21–29, 30–39, 40–49 and 50–59. In other words, this study involved a total sample of 7000 students, stratified by age. The sample consisted of 3355 men and 3645 women between the ages of 21 and 100.

Materials

The survey questionnaire was compiled on the basis of previous studies and in particular the instruments described by Jones and Hosein (2010). Participants were first asked to select the technologies to which they had access for study purposes from those listed in Table 2. Brief explanations were provided where appropriate: for example, "personal digital assistant (PDA) or palm-size computer"; "portable digital music player, eg., MP3 player (not mobile phone)"; "USB memory stick or similar method of transferring files." They were then asked whether they had access to the Internet and, if so, to select the locations where they had Internet access from those listed in Table 3. Those who had access to a mobile phone were asked to select the features that they used regularly from those listed in Table 4.

They were next asked to say how confident they felt undertaking 13 computing tasks, using alternatives labelled "very confident," "fairly confident," "not really confident," "not at all confident" and "never used." They were then asked whether they used various assistive technologies

Table 1: Sample Items in the Approaches to Learning and Studying Inventory

Scale	Sample item
Deep approach	I look at evidence carefully to reach my own conclusion about what I'm studying.
Surface approach	Much of what I learn seems no more than lots of unrelated bits and pieces in my mind.
Monitoring studying	I go over the work I've done to check my reasoning and see that it all makes sense.
Organised studying	I organise my study time carefully to make the best use of it.

(such as screen reading software or speech recognition software) and how much time they spent in an average week using technologies of all kinds (1) for study and (2) for other purposes (choosing one of seven response alternatives between "never" and "over 10 hours").

Finally, they were presented with nine statements about their attitudes to technologies and 18 statements about their approaches to studying. The former are listed in Table 7. The latter were based on the Approaches to Learning and Studying Inventory developed by Entwistle, McCune and Hounsell (2003). This measures the use of a deep approach (six items), a surface approach (four items) and two aspects of a strategic approach (monitoring studying and organised studying, four items each). (The complete questionnaire can be found at the following URL: http://www.etl.tla.ed.ac.uk/questionnaires/ETLQ.pdf.) The original items referred to how students had studied on a particular course. For the present study, their wording was modified to refer to how the respondents studied in general. Sample items for the four scales are shown in Table 1. For each of the 27 items, students were asked to indicate the extent of their agreement with the relevant statement using a 5-point scale. The response alternatives were labelled "totally agree" (scored 5), "somewhat agree" (scored 4), "not sure" (scored 3), "somewhat disagree" (scored 2) and "totally disagree" (scored 1).

Procedure
The questionnaire was prepared both as an online survey and as a postal survey. In June 2010, all 7000 students were contacted by electronic mail and invited to participate in the online survey through a secure dedicated website. However, they were also told that, if they preferred to complete the survey using a paper version of the questionnaire, they would receive one shortly. After 2 weeks, any students who had not responded were sent a reminder letter through the regular mail, together with a paper version of the questionnaire and a prepaid return envelope. The reminder letter invited them to participate by completing the paper version of the questionnaire or by completing the online alternative.

Data analysis
Logistic regression was used to investigate the role of age group, gender and response mode as predictors of whether or not students had access to different technologies. Factor analysis was used to identify distinct scales concerned with confidence in computing and attitudes to technology. Analysis of variance was used to investigate the role of age group, gender and response mode as predictors of students' attitudes to technology. The Kruskal–Wallis test was used to analyse the role of age group, gender and response mode as predictors of the time spent using technologies. Finally, multivariate analysis of variance was used to investigate the role of age group, gender, response mode and attitudes to technology as predictors of students' approaches to studying.

Results
We present in turn results concerning response rate and response mode, the students' access to digital technologies, their access to the Internet, their use of different features of mobile phones,

their confidence in computing, their use of assistive technologies, their attitudes to digital technologies and their approaches to learning and studying.

Respondents

Completed questionnaires were returned by 4066 (or 58.1%) of the students, which would be regarded as a good response rate for a postal survey (Babbie, 1990, p. 182; Kidder, 1981, pp. 150–151). The response rate increased monotonically from 30.8% for students aged 21–29 to 81.2% for those aged 70 and over but was similar in men (57.3%) and women (58.8%).

Of the respondents, 60.4% had responded online, whereas 39.6% had completed the paper questionnaire. The preference for online responding is not surprising, given that the participants were provided with the online survey 2 weeks before the paper survey and given that they were expected to be familiar with the online environment in their academic studies. The percentage of respondents who had responded online increased monotonically from 46.4% for students aged 21–29 to 65.8% in those aged 60–69 and then declined to 60.5% in students aged 70 and over. The percentage of respondents who responded online was similar in the men (61.3%) and the women (59.6%).

Access to digital technologies

Table 2 shows the percentage of respondents in each age group who reported that they had access to different technologies, listed in the order in which they were presented in the questionnaire. These data were analysed using multiple logistic regression with age group, gender and response mode as the predictor variables. Because of the large number of tests of statistical significance in the analysis of the survey data, the threshold probability level (α) was set at .01 to avoid spuriously significant results (ie, type I errors). For brevity, detailed statistical findings are not presented here; however, any relationships, differences or other trends that are reported were statistically significant at this level unless otherwise stated.

Inspection of Table 2 shows that the students in the older age groups were more likely than the students in the younger age groups to have access to a desktop computer, but the students in the younger age groups were more likely than the students in the older age groups to have access to a laptop computer, a mobile phone, a portable digital music player, a handheld games player or a console games player. The middle-aged students were more likely than those in other age groups to have access to a PDA. (Also known as palmtop computers, these devices were popular towards the end of the twentieth century, but nowadays their functionality has largely been superseded by that of smartphones.) The students aged 70 and over were less likely than those in the other age groups to have access to a memory stick.

The men were significantly more likely than the women to have access to a desktop computer, a PDA or a memory stick, but the women were significantly more likely than the men to have access

Table 2: Percentage of students with access to different technologies by age

Technology	21–30	30–39	40–49	50–59	60–69	70 and over
Desktop computer	43.2	54.8	66.4	70.6	68.5	70.0
Laptop computer	86.0	81.7	77.2	74.6	66.8	52.3
Personal digital assistant	3.9	7.0	6.8	7.9	4.9	2.7
Mobile phone	74.4	66.1	70.7	70.1	68.3	56.3
Portable digital music player	45.5	42.8	37.1	34.3	28.7	16.9
USB memory stick	75.3	68.9	72.4	74.3	67.2	45.3
Handheld games player	13.0	10.7	10.2	6.8	3.9	1.6
Console games player	25.0	18.8	15.8	7.0	3.4	1.5

Table 3: Percentage of students with access to the internet by age

Location	21–30	30–39	40–49	50–59	60–69	70 and over
Home	91.2	93.2	93.6	94.4	95.6	93.0
Library or other public facility	11.7	9.4	8.5	7.4	8.2	5.0
Work	42.2	50.1	44.6	41.2	14.5	1.7
Internet café	4.5	3.1	2.1	1.4	2.1	0.7
Home of friend or family member	14.6	6.3	3.5	3.9	3.3	3.0
Anywhere (eg, via mobile phone)	21.1	21.4	18.7	13.0	10.1	3.8

to a handheld games player. There was no significant gender difference in terms of access to a laptop computer, a mobile phone, a portable digital music player or a console games player. The online respondents were significantly more likely than the postal respondents to have access to a memory stick. However, there was no significant difference between the two groups in their access to the other kinds of technology.

Access to the Internet
Nearly all of the respondents (99.2%) had access to the Internet. This proportion varied with age from 100.0% in respondents aged 21–29 to 97.8% in respondents aged 70 and over, and the online respondents were more likely to have access to the Internet than were the postal respondents. However, there was no significant gender difference in terms of access to the Internet. Nearly all the respondents with Internet access (97.1%) used broadband. This proportion did not vary significantly with age or gender, but the online respondents were significantly more likely to use broadband than were the postal respondents.

Table 3 shows the percentage of respondents in each age group who reported that they had access to the Internet in different locations. Inspection of the table shows that the students in the younger age groups were more likely than the students in the older age groups to have Internet access in a library or other public facility, at work, at an Internet café, at the home of a friend or family member or anywhere (eg, via a mobile phone or other portable device). There was no significant age difference in the proportion of respondents who had Internet access at home.

The men were significantly more likely than the women to have Internet access anywhere, but they were significantly less likely than the women to have Internet access at work. Otherwise, there was no significant gender difference in terms of access to the Internet in different locations. The postal respondents were significantly more likely than the online respondents to have Internet access at home, but there was otherwise no significant difference between the two groups in terms of their access to the Internet in different locations.

Features of mobile phones
Table 4 shows the percentage of students with mobile phones in each age group who regularly used different features. The students in the older age groups were less likely than the students in the younger age groups to make or receive text messages, to use a phone as a camera, to use a phone as a music player, to use a phone for internet access or to use WiFi, but there was no significant age difference in the proportion of students who used a phone to make or receive calls.

The men were significantly more likely than the women to use a phone for Internet access or to use WiFi, but they were significantly less likely than the women to use a phone to make or receive text messages or to use a phone as a camera. There was no significant gender difference in the proportion of respondents who used a phone to make or receive calls or who used a phone as a music player. There was no significant difference between the online and the postal respondents in their use of any of the features of mobile phones.

Table 4: Percentage of students who use different features of a mobile phone by age

Features	21–30	30–39	40–49	50–59	60–69	70 and over
Make/receive calls	96.1	92.1	89.4	92.0	92.2	91.5
Make/receive text messages	98.7	95.3	90.6	88.0	77.5	52.3
Camera	46.3	52.2	43.7	36.5	28.0	17.9
Music player	30.1	26.9	19.9	11.3	5.6	2.8
Internet access	42.8	35.2	25.5	16.3	10.1	5.0
WiFi	23.6	26.1	15.5	12.0	7.2	3.1

Table 5: Percentage of students who have never carried out different tasks by age

Task	21–30	30–39	40–49	50–59	60–69	70 and over
Word processing	0.3	1.1	1.3	1.6	1.8	5.1
Email	0.0	0.0	0.2	0.9	0.8	2.8
Spreadsheets	3.0	4.3	8.1	7.7	12.0	21.1
Web searching tools	0.0	0.3	0.6	0.4	0.8	3.0
Internet for shopping	1.4	1.9	2.3	4.1	8.1	17.8
Internet for studying	0.3	0.3	1.3	0.5	2.7	7.5
Internet for online communication	16.9	27.4	34.4	33.7	43.4	52.6
Social networks	9.5	22.0	33.0	44.3	58.1	68.1
Sharing with others	28.4	34.0	47.7	49.2	58.1	67.2
Wikis	8.1	7.6	14.3	16.0	20.1	30.3
Wikis as part of studies	29.7	32.3	40.6	37.6	46.3	51.2
Personal blog	60.1	63.6	67.2	68.7	76.9	79.8
Blog as part of studies	50.8	50.0	58.3	55.8	60.8	64.3

Confidence in computing

The 13 computing tasks are listed in Table 5. Of the 4066 respondents, 3277 reported that they had never used one or more of the digital technologies, leaving 789 respondents with usable data on all 13 items. Their responses were analysed using principal axis factoring and oblique rotation, yielding two factors. One consisted of the first six items, representing basic office functions; the other consisted of the other seven items, representing social networking. The correlation coefficient between the two factors was 0.66, suggesting that students who use digital technologies for office functions are also likely to use them for networking. No further analyses were conducted because the data were only produced by a minority of the respondents.

Table 5 shows the percentage of respondents in each age group who reported that they had never carried out each of the tasks. The students in the older age groups were more likely than the students in the younger age groups to report that they had never carried out each of the 13 tasks.

The women were significantly more likely than the men to report that they had never used spreadsheets, online studying, personal wikis, wikis that were part of their studies or personal blogs, but there was no significant gender difference in the proportion of students who had never used word processing, email, web searching tools, online shopping, online studying, online communication, social networking, or blogs that were part of their studies.

The postal respondents were significantly more likely than the online respondents to report that they had never used word processing, email, spreadsheets, web searching tools, online shopping, online studying or wikis. However, there was no significant difference between the two groups in the percentage who had never used the Internet for online communication, social networking, sharing with others, using wikis that were part of their studies, keeping a personal blog or keeping a blog that was part of their studies.

Assistive technologies
Table 6 shows the percentage of students in each age group who used different assistive technologies. None of the technologies was used by more than 5% of the respondents. There was no significant age difference and no significant gender difference in the use of any of the technologies. The online respondents were significantly more likely to use other kinds of support than the postal respondents, but otherwise there was no significant difference between the two groups.

Time spent using digital technologies
A Kruskal–Wallis test showed that the students in the younger age groups reported that they spent longer using technologies for study than did the students in the older age groups, although the modal response was "1–3 hours" in every age group. The students in the younger age groups also reported that they spent longer using technologies for other purposes: the modal response for the students aged 21–29 was "over 10 hours," whereas the modal response for the students aged 70 and over was "1–3 hours."

There was no significant gender difference in the time spent using technologies either for study or for other purposes. However, the online respondents reported spending significantly longer using technologies both for study and for other purposes than did the postal respondents.

Attitudes to digital technologies
The nine attitudinal statements are shown in Table 7. Of the 4066 respondents, 280 failed to respond to one or more of the statements, leaving 3786 respondents with usable data on all nine

Table 6: Percentage of students who use different assistive technologies by age

Technology	21–30	30–39	40–49	50–59	60–69	70 and over
Text reading software	3.6	3.1	1.7	1.9	1.3	1.5
Screen reading software	0.6	0.3	0.8	0.9	0.4	1.1
Screen magnification software	1.6	1.8	1.7	4.0	3.4	4.6
Speech recognition software	1.3	1.8	2.1	4.4	2.8	3.7
Alternative keyboard or mouse	4.9	5.0	2.9	4.4	4.6	6.3
Digital talking books or ReadOut[a]	2.6	1.6	1.7	0.7	1.3	2.5
Comb-bound materials	4.5	4.2	3.3	4.0	4.2	5.3
Other support	1.9	2.9	2.1	2.6	3.2	5.0

[a]The ReadOut software enables print-disabled students to access course materials by means of a personal computer and an enabling interface such as synthetic speech, text magnification, printed or refreshable Braille or natural-speech audio recordings (see Richardson, 2006).

Table 7: Loading of responses to nine attitudinal statements on two extracted factors

Statement	Factor 1	Factor 2
I have access to all the ICT necessary to study with the OU [Open University].	**0.48**	0.04
I am not clear about how the use of ICT can improve my learning.	**−0.66**	0.13
I enjoy using ICT in my studies.	**0.73**	0.15
I think the importance of using ICT in education is overstated.	**−0.60**	0.00
I am excited by the use of ICT at the OU.	**0.58**	0.27
I am reluctant to use ICT in my OU studies.	**−0.80**	0.08
I work online in groups with other students at the OU.	0.09	**0.45**
I have been able to learn new ICT skills through my OU courses.	−0.04	**0.66**
I have found it easy to contact my OU tutor using ICT.	0.32	0.19

Note: loadings greater than 0.40 in absolute magnitude are shown in bold font.

Response mode	21–30	30–39	40–49	50–59	60–69	70 and over
Online	4.01	4.05	3.89	3.86	3.77	3.50
Postal	4.18	3.92	3.95	3.77	3.59	3.27

Note: scores are on a scale from 1 (*low*) to 5 (*high*).

items. Their responses were analysed using principal axis factoring and oblique rotation, once again yielding two factors. Loadings of 0.40 or more were regarded as salient for the purposes of interpretation. The first factor consisted of the first six items, with positive loadings on the three positively worded items and negative loadings on the three negatively worded items, thus representing (positive) attitudes to technology. The second factor consisted of just two items, apparently representing the learning of new skills using technology. The correlation coefficient between the two factors was .49, suggesting that students with positive attitudes to technology also use technology to learn new skills.

The first six items were used to construct a factor-based scale measuring attitudes to technology: the scale score was the mean of the responses to the six items after the negatively worded items had been coded in reverse. Cronbach's coefficient alpha for this scale was .82, indicating an acceptable level of reliability. No such use was made of the second factor, because it consisted of just two items and was not of acceptable reliability (coefficient alpha = .50).

An analysis of variance was carried out on the students' scores on the factor-based scale using the independent variables of age group, gender and response mode. There were 3812 students with usable data on this measure, and Table 8 shows their mean scores by age and response mode, adjusted for any possible effect of gender. There was a significant effect of age group, $F(5, 3788) = 40.79$, $p < .001$, such that the students in the younger age groups had somewhat more positive attitudes to technology than did the students in the older age groups.

The overall effect of response mode was not statistically significant, but there was a significant interaction between the effects of age group and response mode, $F(5, 3788) = 3.17$, $p = .007$. Table 8 shows that the online respondents had more positive attitudes than did the postal respondents, but this was only apparent in students aged 50 and over. In younger students, there was essentially no difference between online and postal respondents in their attitudes to technology. Finally, there was a significant effect of gender, $F(1, 3788) = 10.33$, $p = .001$, such that the men ($M = 3.87$) had more positive attitudes than the women ($M = 3.76$).

Approaches to learning and studying
Of the 4066 respondents, 267 had not provided a response to one or more of the 18 items in the Approaches to Learning and Studying Inventory. For the 62 students who had missed either one or two items, it was felt appropriate to regard these as items about which the respondents were unsure; accordingly, their missing responses were coded as "3." This yielded 3861 respondents with complete sets of data. They were assigned scores on each of the four scales as the mean of their responses to the relevant items. A more detailed analysis of the students' scores on this questionnaire will be published elsewhere.

A multivariate analysis of variance was carried out on the students' scale scores using age group, gender and response mode as independent variables and attitudes to technology as a covariate. There were 3773 respondents with usable data on both attitudes to technology and approaches to studying. There was a significant multivariate effect of attitudes to technology, $F(4, 3745) = 69.51$, $p < .001$: the students with more positive attitudes had significantly higher scores on deep

Table 9: Mean scores on approaches to studying by age

Scale	21–30	30–39	40–49	50–59	60–69	70 and over
Deep approach	3.96	4.04	4.07	4.14	4.21	4.23
Surface approach	2.45	2.39	2.27	2.20	2.10	2.13
Monitoring studying	3.90	3.98	3.98	4.04	4.06	4.09
Organised studying	3.59	3.78	3.83	3.88	3.96	3.98

Note: scores are on a scale from 1 (*low*) to 5 (*high*).

approach ($B = +0.14$), monitoring studying ($B = +0.13$) and organised studying ($B = +0.13$), and they had significantly lower scores on surface approach ($B = -0.18$) than did the students with less positive attitudes.

Table 9 shows the mean scale scores obtained by the students in different age groups, adjusted for any possible effects of gender, response mode and attitudes to technology. There was a significant multivariate effect of age group, $F(20, 12\ 422) = 6.57$, $p < .001$: the students in the older age groups had slightly but significantly higher scores on deep approach, monitoring studying and organised studying than did the students in the younger age groups, and they had slightly but significantly lower scores on surface approach than did the students in the younger age groups.

There was a significant multivariate effect of gender, $F(4, 3745) = 16.72$, $p < .001$: the women had significantly higher scores on organised studying than did the men. There was, however, no significant gender difference in their scores on deep approach, surface approach or monitoring studying. Finally, there was a significant multivariate effect of response mode, $F(4, 3745) = 5.87$, $p < .001$: the online respondents had significantly higher scores on monitoring studying but significantly lower scores on organised studying than did the postal respondents. There was, however, no significant effect of response mode on their scores on either deep approach or surface approach.

Summary and discussion

As required by their courses, nearly all Open University students have access to a computer (indeed, Table 2 implies that some have access to two or more), and nearly all use broadband. The students in the older age groups were more likely than the students in the younger age groups to respond to our survey, and the students in the older age groups were more likely than the students in the younger age groups to respond online rather on paper. This contrasts with the common assumption that older people have more difficulty using information technology than young adults. On the contrary, when they are given the choice between responding on paper or online, and when they have similar access to relevant forms of technology, older students are more likely to respond to questionnaire surveys online than are younger students, at least in the case of those taking courses with the Open University. This suggests that researchers, practitioners and policy-makers need to beware of accepting lazy stereotypes regarding the abilities and motivation of older people.

The students in the older age groups were more likely than the students in the younger age groups to have access to a desktop computer, but the students in the younger age groups were more likely than the students in the older age groups to have access to a laptop computer and to several other digital technologies. The students in the younger age groups were more likely to have carried out a variety of computing tasks, they were more likely to have access to the Internet in a variety of locations outside their homes, and they were more likely to make use of other features available on mobile phones. Finally, the students in the younger age groups reported that they spent longer using technologies for study and for other purposes than did the students in the older age groups.

Clearly, then, there are age-related differences both in access to digital technology and in the use of digital technology. However, these were all monotonic trends across the adult lifespan. Consistent with the results obtained by Jones *et al* (2010), we found no evidence for any discontinuity in technology use around the age of 30, as would be predicted by the Net Generation and Digital Natives hypotheses.

The students in the younger age groups reported more positive attitudes to technology than did the students in the older age groups. Nevertheless, Table 8 shows that in each age group the mean score was above the midpoint of the response scale (3), indicating broadly positive attitudes to technology regardless of the students' ages. As in the studies carried out by Goodyear *et al* (2003, 2005), Foster and Lin (2007) and Chen *et al* (2010), those students who had more positive attitudes to technology were more likely to adopt a deep approach to studying, they were more likely to adopt a strategic approach to studying, and they were less likely to adopt a surface approach to studying. A deep approach and a strategic approach can be regarded as desirable approaches to studying, insofar as they are compatible with the aims of higher education, whereas a surface approach can be regarded as an undesirable approach. The present findings therefore imply that students with more positive attitudes to technology are more likely to adopt desirable approaches to studying and less likely to adopt undesirable approaches to studying. In the data analysis, students' attitudes to technology were employed as a covariate within the various groups defined by age, gender and response mode. In other words, students' attitudes had a positive effect on their approaches to studying even when the effects of age, gender and response mode on approaches to studying had been controlled.

Also consistent with the findings of previous research (see Baeten *et al*, 2010), the students in the older age groups were more likely to adopt a deep approach, they were more likely to adopt a strategic approach and they were less likely to adopt a surface approach than the students in the younger age groups. In other words, older students are more likely to adopt desirable approaches to studying and are less likely to adopt undesirable approaches to studying than are younger students. In the data analysis, a student's age group was employed as an independent variable whose effect was statistically adjusted for the effects of the other independent variables and the covariate. In other words, students' age had a positive effect on their approaches to studying even when the effects of gender, response mode and attitudes to technology on approaches to studying had been controlled.

In short, this study has demonstrated that students' age and their attitudes to digital technology are distinct predictors of their approaches to studying in distance education. The study suffers from three main limitations. First, we did not include a comparison group of students aged under 21, and consequently, the overlap between our participants and students in campus-based education is imperfect. Second, we did not ask students about their use of the newest forms of technology, such as e-book readers and tablet computers. Pedagogical practices in both campus-based and distance education need to exploit the opportunities offered by these devices, which may well be more accessible for all groups of students than older forms of technology. Third, we did not collect data about our students' academic attainment on their courses. The relationship between approaches to studying and academic attainment is not straightforward and depends on the nature of the outcomes being assessed (see Richardson, 2000, pp. 182–183). Hence, the question whether students' age and attitudes to technology predict their attainment needs to be addressed quite separately from whether they predict their approaches to studying.

The most commonly suggested explanation for the effect of age on approaches to studying is that older students are more likely than younger students to be studying out of intrinsic interest or for their own personal development (see eg, Gow & Kember, 1990; Richardson, 1994; Watkins, 1982). There is indeed evidence from interview-based studies to support this suggestion (eg,

Gibbs, Morgan & Taylor, 1984). The observation that students' attitudes to technology are likewise correlated with their approaches to studying such that more positive attitudes are associated with the adoption of more desirable approaches has now been shown to generalise from campus-based education to distance education. This observation is of considerable significance because it suggests that in both kinds of setting and whatever their age today's students regard the use of digital technologies as an integral part of their experience of higher education.

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References

Babbie, E. R. (1990). *Survey research methods* (2nd ed.). Belmont, CA: Wadsworth.

Baeten, M., Kyndt, E., Struyven, K. & Dochy, F. (2010). Using student-centred learning environments to stimulate deep approaches to learning: factors encouraging or discouraging their effectiveness. *Educational Research Review*, 5, 243–260. doi:10.1016/j.edurev.2010.06.001

Bennett, S., Maton, K. & Kervin, L. (2008). The "digital natives" debate: a critical review of the evidence. *British Journal of Educational Technology*, 39, 775–786. doi:10.1111/j.1467-8535.2007.00793.x

Brown, T., Hewitt, R., Jenkins, M., Voce, J., Walker, R. & Yip, H. (2010). *2010 survey of technology enhanced learning for higher education in the UK*. Oxford: Universities and Colleges Information Systems Association. Retrieved online 16/02/12, from http://www.ucisa.ac.uk/en/publications/tel_survey2010.aspx

Chen, P.-S. D., Lambert, A. D. & Guidry, K. R. (2010). Engaging online learners: the impact of web-based learning technology on college student engagement. *Computers and Education*, 54, 1222–1232. doi:10.1023/A:1021363527731

Dahlstrom, E., de Boor, T., Grunwald, P. & Vockley, M. (2011). *ECAR national study of undergraduate students and information technology, 2011*. Boulder, CO: EDUCAUSE Center for Applied Research. Retrieved online 16/02/12, from http://net.educause.edu/ir/library/pdf/ERS1103/ERS1103W.pdf

Entwistle, N., McCune, V. & Hounsell, J. (2003). Investigating ways of enhancing university teaching–learning environments: measuring students' approaches to studying and perceptions of teaching. In E. De Corte, L. Verschaffel, N. Entwistle & J. van Merriënboer (Eds), *Powerful learning environments: unravelling basic components and dimensions* (pp. 89–107). Oxford: Pergamon.

Foster, J. & Lin, A. (2007). Approaches to studying and students' use of a computer supported learning environment. *Education for Information*, 25, 155–168.

Gibbs, G., Morgan, A. & Taylor, E. (1984). The world of the learner. In F. Marton, D. Hounsell & N. Entwistle (Eds), *The experience of learning* (pp. 165–188). Edinburgh: Scottish Academic Press.

Goodyear, P., Asensio, M., Jones, C., Hodgson, V. & Steeples, C. (2003). Relationships between conceptions of learning, approaches to study and students' judgements about the value of their experiences of networked learning. *ALT-J: Research in Learning Technology*, 11, 1, 17–27. doi:10.1080/0968776030110103

Goodyear, P., Jones, C., Asensio, M., Hodgson, V. & Steeples, C. (2005). Networked learning in higher education: students' expectations and experiences. *Higher Education*, 50, 473–508. doi:10.1007/s10734-004-6364-y

Gow, L. & Kember, D. (1990). Does higher education promote independent learning? *Higher Education*, 19, 307–322. Retrieved online 16/02/12, from http://www.jstor.org/stable/3447274

Graham, M. (2011). Time machines and virtual portals: the spatialities of the digital divide. *Progress in Development Studies*, 11, 211–217. doi:10.1177/146499341001100303

Hawkins, B. L. & Rudy, J. A. (2008). *EDUCAUSE core data service 2007 summary report*. Boulder, CO: EDUCAUSE. Retrieved online 16/02/12, from http://net.educause.edu/ir/library/pdf/PUB8005.pdf

Howe, N. & Strauss, W. (2003). *Millennials go to college: strategies for a new generation on campus*. Washington, DC: American Association of Collegiate Registrars and Admissions Officers.

Jones, C. (2011). Students, the Net Generation, and digital natives: accounting for educational change. In M. Thomas (Ed.), *Deconstructing digital natives: young people, technology and the new literacies* (pp. 30–45). New York: Routledge.

Jones, C. & Hosein, A. (2010). Profiling university students' use of technology: where is the Net Generation divide? *International Journal of Technology, Knowledge and Society*, 6, 3, 43–58.

Jones, C., Ramanau, R., Cross, S. & Healing, G. (2010). Net generation or Digital Natives: is there a distinct new generation entering university? *Computers and Education*, 54, 722–732. doi:10.1016/j.compedu.2009.09.022

Jorgensen, B. (2003). Baby Boomers, Generation X and Generation Y? Policy implications for defence forces in the modern era. *Foresight*, 5, 4, 41–49. doi:10.1108/14636680310494753

Kennedy, G. E., Judd, T. S., Churchward, A., Gray, K. & Krause, K.-L. (2008). First-year students' experiences with technology: are they really digital natives? *Australasian Journal of Educational Technology*, 24, 108–122. Retrieved online 16/02/12, from http://www.ascilite.org.au/ajet/ajet24/kennedy.pdf

Kidder, L. H. (1981). *Sellitz, Wrightsman and Cook's research methods in social relations* (4th ed.). New York: Holt, Rinehart and Winston.

Oblinger, D. (2003). Boomers, Gen-Xers, and Millennials: understanding the new students. *EDUCAUSE Review*, 38, 4, 37–47. Retrieved online 16/02/12, from http://net.educause.edu/ir/library/pdf/ERM0342.pdf

Peacock, S. E. & Künemund, H. (2007). Senior citizens and Internet technology: reasons and correlates of access versus non-access in a European comparative perspective. *European Journal of Ageing*, 4, 191–200. doi:10.1007/s10433-007-0067-z

Pedró, F. (2009). *New millennium learners in higher education: evidence and policy implications*. Paris: Organisation for Economic Co-operation and Development, Centre for Educational Research and Innovation. Retrieved online 16/02/12, from http://www.pgce.soton.ac.uk/ict/NewPGCE/PDFs10/NML-in-Higher-Education.pdf

Prensky, M. (2001a). Digital natives, digital immigrants Part 1. *On the Horizon*, 9, 5, 1–6.

Prensky, M. (2001b). Digital natives, digital immigrants Part 2: do they really think differently? *On the Horizon*, 9, 6, 1–6.

Prensky, M. (2009). H. sapiens digital: from digital immigrants and digital natives to digital wisdom. *Innovate*, 5, 3. Retrieved online 16/02/12, from http://www.innovateonline.info/index.php?view=article&id=705

Prensky, M. (2010). *Teaching digital natives: partnering for real learning*. Thousand Oaks, CA: Corwin Press.

Richardson, J. T. E. (1994). Mature students in higher education: I. A literature survey on approaches to studying. *Studies in Higher Education*, 19, 309–325. doi:10.1080/03075079412331381900

Richardson, J. T. E. (2000). *Researching student learning: approaches to studying in campus-based and distance education*. Buckingham: Society for Research into Higher Education and Open University Press.

Richardson, J. T. E. (2006). Perceptions of academic quality and approaches to studying among students with print disabilities enrolled in distance education. *Journal of Postsecondary Education and Disability*, 19, 56–70.

Selwyn, N. (2009). The digital native: myth and reality. *Aslib Proceedings*, 61, 364–379. doi:10.1108/00012530910973776

Shieh, R. S., Chang, S.-L. & Liu, E. Z.-F. (2011). A case study of low-status women's attitudes towards computers. *Educational Studies*, 37, 233–243. doi:10.1080/03055698.2010.506339

Smith, S. D. & Caruso, J. B. (2010). *ECAR study of undergraduate students and information technology, 2010 (ECAR report no. 6)*. Boulder, CO: EDUCAUSE Center for Applied Research. Retrieved online 16/02/12, from http://net.educause.edu/ir/library/pdf/ERS1006/RS/ERS1006W.pdf

Strauss, W. & Howe, N. (1991). *Generations: the history of America's future, 1584 to 2069*. New York: Quill.

Student perspectives on technology: demand, perceptions and training needs. (2010). Bristol, UK: Higher Education Funding Council for England. Retrieved online 16/02/12, from http://www.hefce.ac.uk/pubs/rdreports/2010/rd18_10/rd18_10.pdf

Tapscott, D. (1998). *Growing up digital: the rise of the Net Generation*. New York: McGraw-Hill.

Tapscott, D. (2009). *Grown up digital: how the Net Generation is changing your world*. New York: McGraw-Hill.

Wagner, N., Hassanein, K. & Head, M. (2010). Computer use by older adults: a multi-disciplinary review. *Computers in Human Behavior*, 26, 870–882. doi:10.1016/j.chb.2010.03.029

Watkins, D. (1982). Identifying the study process dimensions of Australian university students. *Australian Journal of Education*, 26, 76–85.